What is Claimed is:

1. A reciprocating and rotating magnetic refrigeration apparatus for magnetizing and demagnetizing a magnetocaloric material through reciprocating and rotational motion, comprising:

a rotor located in the center of the apparatus and embedded with freely rotating permanent magnets;

an annular stator surrounding the rotor containing a permanent magnet;

an even number of equally spaced stator nose poles on the inner perimeter of the stator having with the head attached to the magnetocaloric material;

Magnetic supply coils surrounding the stator nose poles receiving current alternately across two adjoining coils to generate magnetic resistance and magnetic torque to attract the rotor to rotate reciprocally, the permanent magnets of the rotor and the electromagnetic field generated by the magnetic supply coils form a magnetic path alternately to magnetize and demagnetize the magnetocaloric material thereby altering the temperature and entropy of the magnetocaloric material; and

a heat transfer unit for discharging generated heat energy.

2. The reciprocating and rotational magnetic refrigeration apparatus of claim 1, wherein the number of the permanent

magnets embedded in the rotor is one-half of the stator nose poles.

3. The reciprocating and rotary magnetic refrigeration apparatus of claim 1, wherein the permanent magnets embedded in the rotor form a horseshoe shape.

4. The reciprocating and rotary magnetic refrigeration apparatus of claim 1, wherein each of the stator nose poles has one distal end facing the permanent magnets of the rotor, coupled with a flux concentrator.

5. The reciprocating and rotary magnetic refrigeration apparatus of claim 1, wherein the magnetocaloric material is made of a rare earth metal Gadolinium.

6. The reciprocating and rotary magnetic refrigeration apparatus of claim 1, wherein the heat transfer unit includes:

A first heat transfer tube and a second heat transfer tube in contact with the magnetocaloric material; and

A flow control valve for processing heat transfer through the heat transfer tubes to perform heat exchange between the magnetocaloric material and atmosphere to achieve the cooling effect.

7. A reciprocating and rotary magnetic refrigeration apparatus for magnetizing and demagnetizing a magnetocaloric material to achieve the cooling effect, comprising:

a rotor located in the center of the apparatus and embedded with freely rotating permanent magnets;

an annular stator surrounding the rotor containing a permanent magnet;

an even number of equally spaced stator nose poles on the inner perimeter of the stator their heads attached to the magnetocaloric material;

Magnetic supply coils surrounding the stator nose poles and receiving current alternately on two adjacent coils to generate magnetic resistance and magnetic torque to attract the rotor to rotate reciprocally, the permanent magnets of the rotor and the electromagnetic field generated by the magnetic supply coils form a magnetic path alternate to magnetize and demagnetize the magnetocaloric material thereby altering the temperature and entropy of the magnetocaloric material; and

a heat transfer unit for discharging generated heat energy.

8. The reciprocating and rotating magnetic refrigeration apparatus of claim 7, wherein the number of the permanent magnets embedded in the rotor is one-half of the stator nose poles.

9. The reciprocating and rotary magnetic refrigeration apparatus of claim 7, wherein the permanent magnets embedded in the rotor form a horseshoe shape.

10. The reciprocating and rotary magnetic refrigeration apparatus of claim 7, wherein each of the stator nose poles has one distal end facing the permanent magnets of the rotor

coupled with a flux concentrator.

11. The reciprocating and rotary magnetic refrigeration apparatus of claim 7, wherein the magnetocaloric material is made of a rare earth metal Gadolinium.

12. The reciprocating and rotary magnetic refrigeration apparatus of claim 7, wherein the heat transfer unit includes a first heat transfer tube and a second heat transfer tube, that the tubes are in contact with the magnetocaloric material for processing heat transfer to perform heat exchange between the magnetocaloric material and atmosphere to achieve the cooling effect.

13. The reciprocating and rotary magnetic refrigeration apparatus of claim 12, wherein the first heat transfer tube and the second heat transfer tube are siphon-type miniature tubes.

14. The reciprocating and rotary magnetic refrigeration apparatus of claim 12, wherein the first heat transfer tube and the second heat transfer tube have respectively partial contact with the magnetocaloric material attached to two lateral surfaces of the stator nose poles, with the remainder extending outside the apparatus.

15. The reciprocating and rotary magnetic refrigeration apparatus of claim 14, wherein the first heat transfer tube and the second heat transfer tube alternate heat transfer includes a flow control valve to switch flow paths, the first heat transfer tube and the second heat transfer tube perform heat transfer

for the magnetocaloric material located on any two adjacent stator nose poles.

16. The reciprocating and rotary magnetic refrigeration apparatus of claim 15 further having a heat absorption device and a heat discharge device, the flow control valve has a first connection port and a second connection port on one side thereof to connect respectively to the first heat transfer tube and the second heat transfer tube, a third connection port and a fourth connection port on another side thereof to connect respectively to the heat absorption device and the heat discharge device.

17. The reciprocating and rotary magnetic refrigeration apparatus of claim 16, wherein the heat discharge device absorbs heat generated by the magnetocaloric material and discharges it outdoors, the heat absorption device absorbs heat from the atmosphere and transfers it to the magnetocaloric material cooled by demagnetization.

18. The reciprocating and rotary magnetic refrigeration apparatus of claim 16, wherein the heat absorption device and the heat discharge device are siphon-type miniature tubes that have a greater heat transfer area than the first heat transfer tube and the second heat transfer tube.